RAS-1R Sensor #108 Status

U.S. AIR FORCE

Intelligence, Surveillance, and Reconnaissance Management Directorate

SIWG-10

Jim Godfrey & Kim Thomas

WR-ALC/LXAS

This briefing is unclassified

Incident Description

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- **On June 10, 2004 Kit #108 (PME1 only) suffered an overheating event in the SIL at Palmdale**
  - **Power inadvertently applied to the system without proper cooling**
  - **Situation discovered after approx 90 minutes of operation**
- **The system was immediately powered down upon discovery**
- **An IR temperature reading of 103 ºC was made 10 minutes after power down --LCRS case temperature**
- **System was returned to Associate lab for evaluation**
  - **7 OADC cards failed BIT1 at initial test**
  - **The remainder of the system was operational (initial check)**

Post Incident Activities

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- **Evaluation team assembled and dispatched to Palmdale**
- **Limited temperature testing performed to be retained for future thermal analysis (5ºC to 35ºC)**
- **Initial course of action including evaluation/test strategies were planned and agreed upon**
- **Major Areas of concern**
  - **Short/Long term reliability**
  - **Physical component defects**
  - **RF performance**
  - **Not a Safety of Flight issue**
- **Decision made to return PME-1 to plant for detailed testing/visual inspection**
- **Corrective action taken to update SIL procedures**

Meeting Activity Summary

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- 22,23 June 04 Palmdale TIM
- 1 July 04 Telecon
- 7 July 04 TIM @ Falls Church
- 21 July 04 Jim Godfrey visit to FC
- 22 July 04 Telecon

- Next Planned Meeting - 12 Aug 04 TIM @ Falls Church

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Design Assumptions for Cooling

- **Normal operating conditions (in flight):**
  - **The LCRS fluid pumps are active**
    - **Thermal shut downs for both low and high temperature**
    - **Via fluid temperature sensing, High = =48°C , Low = -27°C**
  - **Ambient ram air is used for cooling**
    - **-65°C to +15°C ambient, -20°C cold start, 70K ft (+10%) (per SP-4221)**

- **Pre-flight operating conditions (ground rings):**
  - **The LCRS fluid pumps are active**
  - **Cooling carts are used to substitute for ram air**
    - **Cooling cart 'ram air' 10°C to 27°C, 60-100 lbs/min**
    - **Operation for 10 minutes at +71°C (per SP-4221) without cooling cart**

- **Under lab operating conditions**
  - **The LCRS fluid pumps are not active**
    - **A chiller is used to maintain fluid temperature**
  - **Rack fixture fans are used to cool other units**
    - **Preselector Chassis, ATM Switch, HB Chassis, Other RAM-Air units**
  - **Other units cooled by natural convection**

System Overview – Areas of Concern

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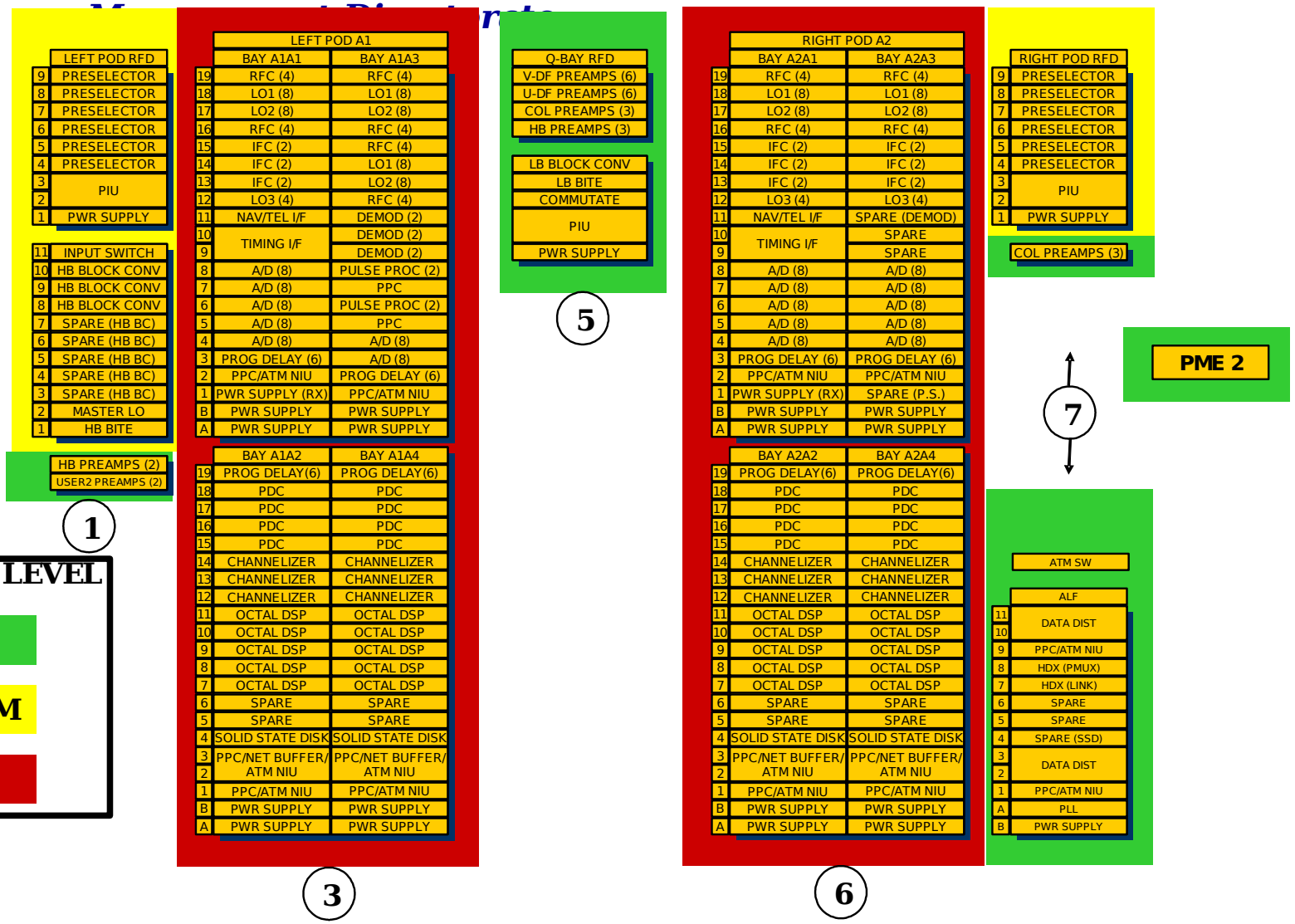

Top Level Schedule

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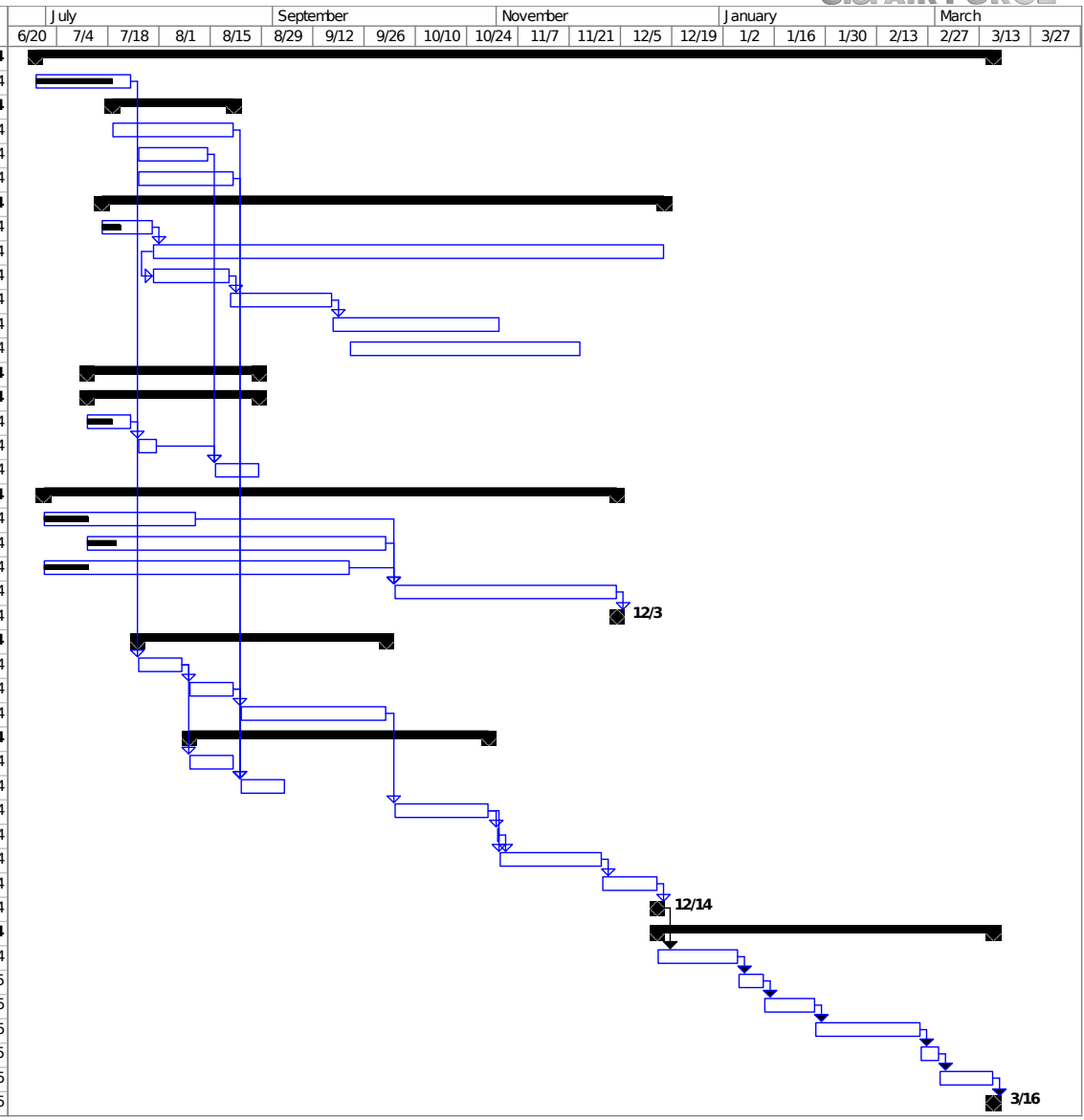
ID	Task Name	May Duration	Start
1	**Kit #108 Task Timline**	**181 days**	**Mon 6/28/04**
2	Visul Inspection	4 wks	Mon 6/28/04
3	**CCA Repair**	**25 days**	**Mon 7/19/04**
4	Initial Visual Defects	25 days	Mon 7/19/04
5	Thread Test Set ATP/Repair	15 days	Mon 7/26/04
6	2nd Card Set for Visual Insp/18A/ATP	20 days	Mon 7/26/04
7	**CALCE Support**	**110 days**	**Fri 7/16/04**
8	Negotiate SOW	10 days	Fri 7/16/04
9	Under Subcontract (Term TBD)	20 wks	Fri 7/30/04
10	OADC Failure Analysis	15 days	Fri 7/30/04
11	Tantalum Capacitor Failures Analysis Support	20 days	Fri 8/20/04
12	Other Task Orders (TBD)	32 days	Fri 9/17/04
13	Support to Report Generation	45 days	Wed 9/22/04
14	**Thread Tests**	**35 days**	**Mon 7/12/04**
15	**Thread Set Up**	**35 days**	**Mon 7/12/04**
16	SW	2 wks	Mon 7/12/04
17	HW	1 wk	Mon 7/26/04
18	Perform Tests	2 wks	Mon 8/16/04
19	**Analysis**	**113 days**	**Wed 6/30/04**
20	Thermal	6 wks	Wed 6/30/04
21	Circuit	12 wks	Mon 7/12/04
22	Component	12 wks	Wed 6/30/04
23	Report Generation	45 days	Mon 10/4/04
24	Supporting Analysis Complete	0 days	Fri 12/3/04
25	**Rack 3**	**50 days**	**Mon 7/26/04**
26	Retest Rack 3	2 wks	Mon 7/26/04
27	Assemble Rack 3 (Using cards w/ no reported defects)	2 wks	Mon 8/9/04
28	Rack 3 ESS	6 wks	Mon 8/23/04
29	**Rack 6**	**60 days**	**Mon 8/9/04**
30	Retest Rack 6	2 wks	Mon 8/9/04
31	Assemble Rack 6 (w/balance of RWK/retested cards)	2 wks	Mon 8/23/04
32	Rack 6 ESS	4 wks	Mon 10/4/04
33	Test Readiness Review	1 day	Mon 11/1/04
34	System ATP	4 wks	Tue 11/2/04
35	Pack and Ship	11 days	Tue 11/30/04
36	Arrive @ PMD	0 wks	Tue 12/14/04
37	**Flight Test**	**59 days**	**Wed 12/15/04**
38	Associate Lab Tests	9 days	Wed 12/15/04
39	SIL Tests	5 days	Thu 1/6/05
40	Upload	2 wks	Thu 1/13/05
41	Flight (9)	21 days	Thu 1/27/05
42	Download	3 days	Fri 2/25/05
43	Pack and Ship	11 days	Wed 3/2/05
44	Beale AFB	0 days	Wed 3/16/05



CCA Inspection, Test, and Repair

- Visual inspection of racks 3 and 6 complete
- Test Status
  - Rack 3 chassis in functional test
    - 2 Sub-motherboards are in test prior to reinstallation into rack 3
    - All Rack 3 power supplies tested, all passed
  - 3 OADC CCAs are in temperature test
  - HB Chassis and Preamp tests to be performed, not self cooled
  - Outsource ROC40 temperature tests
  - Temperature test PD, PDC, CHAN stand alone
  - Enclosed RF LRUs under examination
    - One set undergoing temperature test (in planning) followed by ATP
    - One set being disassembled for visual followed by ATP
  - ESS test set up and planning has begun

Rack Map of Failed CCAs

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PMD Reported Failures

Visual Defects (Burned/Lifted Components) @ FC

Wear & Tear/ Minor @ FC

LEFT POD A1

	BAY A1A1	BAY A1A3	
18	RFC (4)	RFC (4)	19
17	LO1 (8)	LO1 (8)	18
16	LO2 (8)	LO2 (8)	17
15	RFC (4)	RFC (4)	16
14	IFC (2)	RFC (4)	15
13	IFC (2)	LO1 (8)	14
12	IFC (2)	LO2 (8)	13
11	LO3 (4)	RFC (4)	12
10	NAV/TEL I/F	DEMOD (2)	11
9	TIMING I/F	DEMOD (2)	10
8		DEMOD (2)	9
7	A/D (8)	Pulse Proc (2)	8
6	A/D (8)	PPC	7
5	A/D (8)	Pulse Proc (2)	6
4	A/D (8)	PPC	5
3	A/D (8)	A/D (8)	4
2	PROG DELAY (6)	A/D (8)	3
1	PPC/ATM NIU	PROG DELAY (6)	2
C	PWR SUPPLY (RX)	PPC/ATM NIU	1
B	PWR SUPPLY	PWR SUPPLY	B
A	PWR SUPPLY	PWR SUPPLY	A

	BAY A1A2	BAY A1A4	
19	PROG DELAY(6)	PROG DELAY(6)	19
18	PDC	PDC	18
17	PDC	PDC	17
16	PDC	PDC	16
15	PDC	PDC	15
14	CHANNELIZER	CHANNELIZER	14
13	CHANNELIZER	CHANNELIZER	13
12	CHANNELIZER	CHANNELIZER	12
11	OCTAL DSP	OCTAL DSP	11
10	OCTAL DSP	OCTAL DSP	10
9	OCTAL DSP	OCTAL DSP	9
8	OCTAL DSP	OCTAL DSP	8
7	OCTAL DSP	OCTAL DSP	7
6	SPARE	SPARE	6
5	SPARE	SPARE	5
4	PPC/NET BUFFER/ ATM NIU	PPC/NET BUFFER/ ATM NIU	4
3			3
2	SOLID STATE DISK	SOLID STATE DISK	2
1	PPC/ATM NIU	PPC/ATM NIU	1
B	PWR SUPPLY	PWR SUPPLY	B
A	PWR SUPPLY	PWR SUPPLY	A

RIGHT POD A2

	BAY A2A1	BAY A2A3	
18	RFC (4)	RFC (4)	18
17	LO1 (8)	LO1 (8)	17
16	LO2 (8)	LO2 (8)	16
15	RFC (4)	RFC (4)	15
14	IFC (2)	IFC (2)	14
13	IFC (2)	IFC (2)	13
12	IFC (2)	IFC (2)	12
11	LO3 (4)	LO3 (4)	11
10	NAV/TEL I/F	SPARE (NAV)	10
9	TIMING I/F	SPARE	9
8		SPARE(TIMING)	8
7	A/D (8)	A/D (8)	7
6	A/D (8)	A/D (8)	6
5	A/D (8)	A/D (8)	5
4	A/D (8)	A/D (8)	4
3	A/D (8)	A/D (8)	3
2	PROG DELAY (6)	PROG DELAY (6)	2
1	PPC/ATM NIU	PPC/ATM NIU	1
C	PWR SUPPLY (RX)	SPARE (P.S.)	C
B	PWR SUPPLY	PWR SUPPLY	B
A	PWR SUPPLY	PWR SUPPLY	A

	BAY A2A2	BAY A2A4	
19	PROG DELAY(6)	PROG DELAY(6)	19
18	PDC	PDC	18
17	PDC	PDC	17
16	PDC	PDC	16
15	PDC	PDC	15
14	CHANNELIZER	CHANNELIZER	14
13	CHANNELIZER	CHANNELIZER	13
12	CHANNELIZER	CHANNELIZER	12
11	OCTAL DSP	OCTAL DSP	11
10	OCTAL DSP	OCTAL DSP	10
9	OCTAL DSP	OCTAL DSP	9
8	OCTAL DSP	OCTAL DSP	8
7	OCTAL DSP	OCTAL DSP	7
6	SPARE	SPARE	6
5	SPARE	SPARE	5
4	PPC/NET BUFFER/ ATM NIU	PPC/NET BUFFER/ ATM NIU	4
3			3
2	SOLID STATE DISK	SOLID STATE DISK	2
1	PPC/ATM NIU	PPC/ATM NIU	1
B	PWR SUPPLY	PWR SUPPLY	B
A	PWR SUPPLY	PWR SUPPLY	A

Components and Failure Analysis

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- **Tantalum capacitors**
  - **Study continues on temperature derating**
    - **Applied voltage vs. derated voltage comparison and potential links to failures**
- **Integrated circuits**
  - **List of devices being generated**
    - **Ranked first by power consumption**
    - **Capture maximum junction temperature limits**
    - **Awaiting thermal analysis results to calculate actual junction temperatures**
    - **Focus on devices using multiple supply voltages**
- **CALCE laboratory and research facilities at the Univ. of Maryland will be used for component failure analysis and reliability assessments for the effort**

THERMAL ANALYSIS

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- **A single bay of a the LCRS has been modeled**
  - **Additional three bays to be added**
- **Current model is a convection model only**
  - **Radiation to be added**
- **Currently a bulk model**
  - **Model is high level using all applicable parameters**
    - **Materials, geometry, power, etc.**
- **The ambient room temperature is assumed to be 70 F.**

Preliminary Thermal Analysis Results

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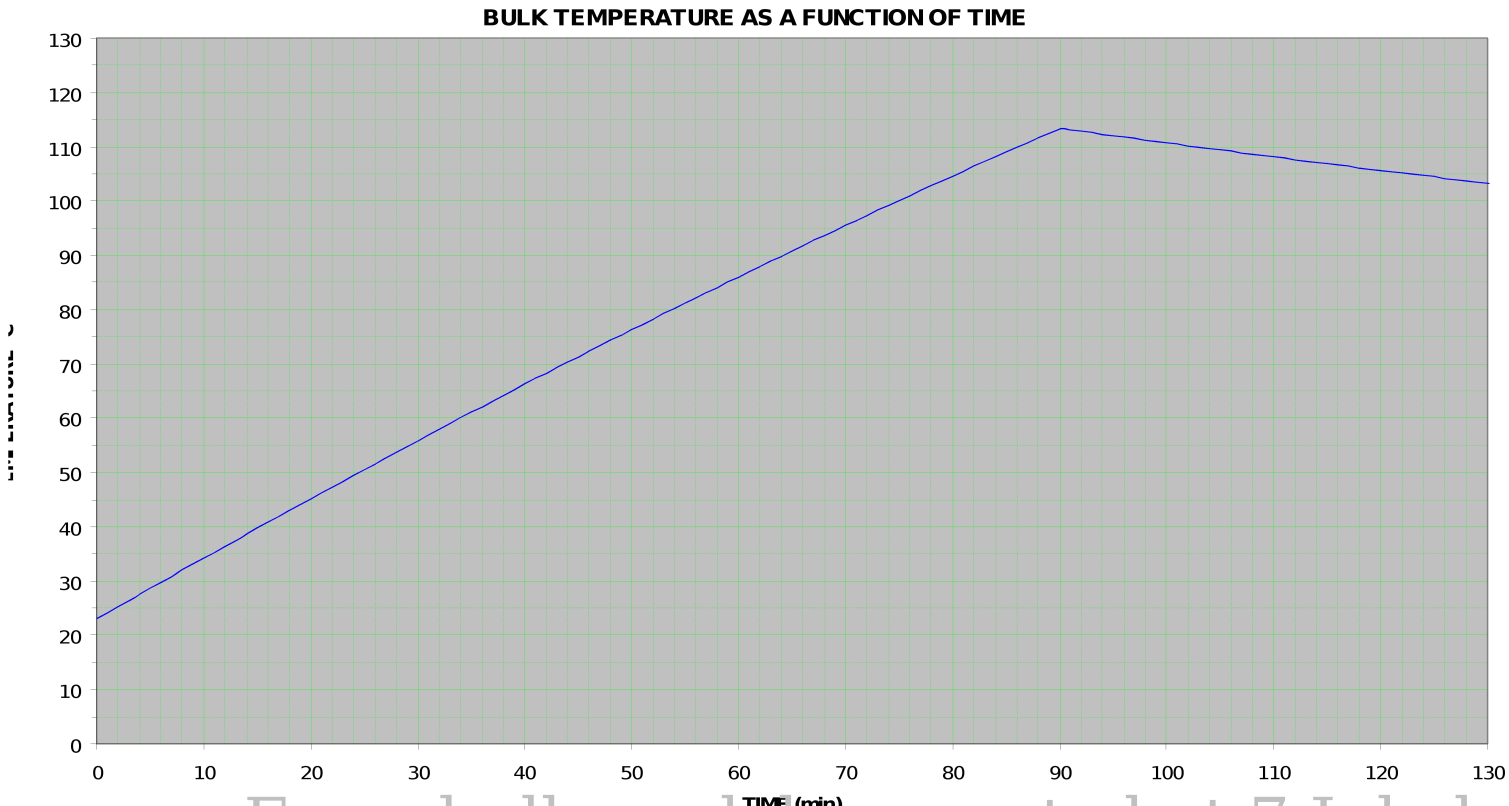

From bulk model presented at 7 July brief

CURRENT ANALYSIS RESULTS

Temperature in °F after 2090 seconds (35 min) of power on.
Convection is applied to top, bottom, left end, and front length
Slot 18 is on left with power supplies on right. Top cover and CCAs removed for clarity

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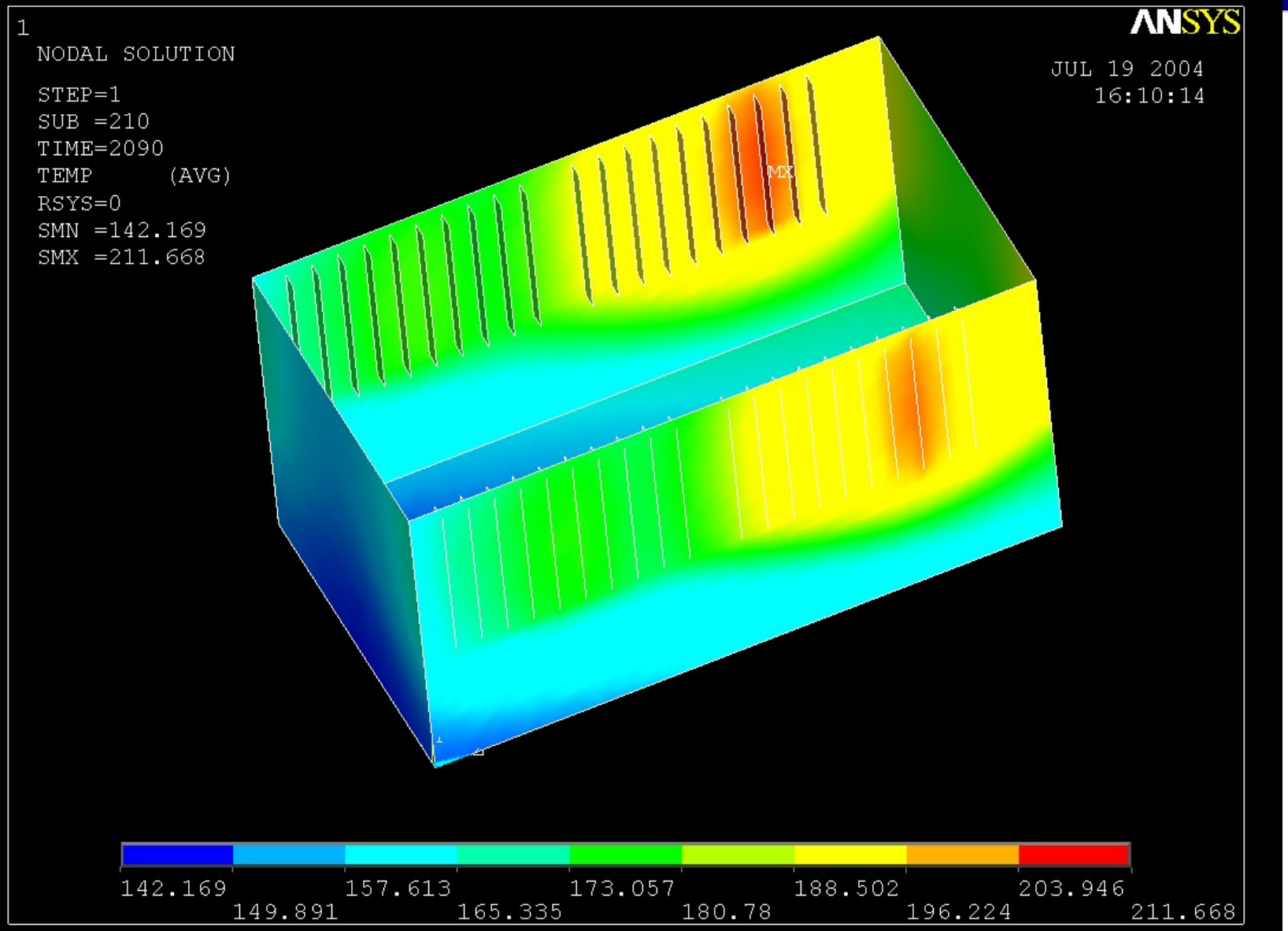

°F	°C
142	61
149	65
157	69.5
165	73.8
173	78.3
181	82.7
188	86.6
196	91.1
204	95.5
212	100

Current Thermal Analysis Conclusions

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- **After ~35 min (2090 seconds) the sidewalls around the power supplies will have reached a temperature where they may begin to shutdown.**
- **Because of variations in thermal switches and similar temperatures shown for each power supply slot, *it is not yet possible to determine which supply shuts down first*.**
- **Because radiation is not yet included, the analysis shows the sidewalls reaching this temperature earlier than actual.**
- **More analysis required to include radiation and results after power supply shutdown.**